

logy, which acts as a clearing-house and headquarters for Applied Entomology throughout the Empire, and of its off-shoot, the Laboratory at Farnham Royal (established in 1927) which deals annually with many species of diptera in the course of its work of breeding beneficial parasites.

ECONOMIC ENTOMOLOGY.

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In most branches of Entomology the progress during the last half-century is a development of previous lines. Economic Entomology, however, has witnessed a revolution in that time. In 1890 the United States was the only country in the world which maintained anything worthy of the name of a staff of Economic Entomologists and even there the Federal Staff was small, with a budget of only some £6000 a year. Nowadays almost every small colony throughout the world has its Government Entomologist and larger countries have a proportionally larger staff (the Federal Service in the U.S.A. now includes several hundred trained workers*). This increase in Government workers has been due directly to the recognition of the great losses caused by Insects, by native pests to home-grown crops, by new pests introduced from other countries, and by insect vectors of human and animal diseases. The damage to crops and stored products by native insect-pests has always been present and may be very serious, especially in warmer countries; that due to pests introduced from other countries became accentuated with the speeding-up of oversea transport and the introduction of new plants from one country to another; that due to insect vectors of disease has only been realized within the last half-century. Although the rôle of the mosquito in carrying the filarial worm causing elephantiasis was discovered by Sir Patrick Manson in 1879, it was not until 1898 that Anopheline mosquitos were definitely incriminated as vectors of malaria; thereafter, progress was relatively rapid and revealed the part played by mosquitos in the carriage of Yellow and Dengue Fevers, by Tsetse Flies as carriers of Sleeping Sickness and Nagana, by Fleas in connection with Plague, by Lice in the transmission of Typhus, and other similar cases, which have largely revolutionized the practice of Tropical Medicine. The recognition of the great importance of insect-borne diseases in the Tropics led directly to the foundation of the Schools of Tropical Medicine in Liverpool, London, Hamburg, and other centres, and, of course, to the practical application of the new knowledge of the control of such diseases as Malaria, Plague, and Yellow Fever. The history of Medical Entomology has been told and re-told in numerous text-books and general accounts and there is no space even to summarize it here, but it may be noted *en passant* that such groups as the Mosquitos, Fleas, and Lice, almost wholly neglected fifty years ago, have received an enormous amount of attention, biologic and taxonomic, resulting in an immense mass of literature. Van der Wulp's *Catalogue of the Diptera of Southern Asia* (1896)

*The appropriations for the U.S. Bureau of Entomology in the decade 1921-1930 amounted to 31,804,716 dollars, in addition to special appropriations of 10,000,000 dollars for Corn-borer Control in 1927 and of 4,250,000 dollars for Mediterranean Fruit-fly in 1929.

was able to enumerate only four species of Indian Culicidae; nowadays more than ten times this number of Indian Anophelines only are known, besides some two hundred species of Culicines. The recognition of the different species of Rat-fleas has elucidated problems of the apparently erratic distribution of Plague in various localities. In such cases—and, indeed, in almost all cases—Applied Entomology, to be really successful, must receive full support from the two branches of Systematics and Bionomics. As has been urged previously on more than one occasion, real success in economic work can only be secured if built up on a firm foundation of knowledge of the systematics and life-history (in the widest sense of the word) of the insects concerned, of control-measures as applied to insects generally, and of some knowledge of the particular subject (agriculture, forestry, medical or veterinary science, etc.) with which any particular insect is concerned, and, to attain the best results, the three branches of systematic, life-history, and applied work must go hand-in-hand. Systematic or life-history work is each valuable in itself and can be pursued as a separate subject, but the knowledge so attained can only be regarded as comparatively useless if merely gathered for its own sake and not applied as helping on the Great War against Waste in which we are constantly engaged with the Insect World. Economic work, considered solely by itself, tends to become mere eye-wash and perfunctory routine and the so-called economic worker who has no use for systematic work is always liable to make serious mistakes by his failure to distinguish between closely-related insects. But, if the three branches are all considered together, each will be found to afford to the others that mutual help which makes for real advances in knowledge. In this way, even the pure systematist may be regarded as an economic worker of the greatest assistance to the economic entomologist who is not too rabidly a pure economist to despise such help. In the case of malarial mosquitos, for example, it is not every Anopheline species which is able to carry the malarial parasite, and successful control-measures must rely on careful preliminary studies of the identity and life-histories of the species occurring in each area concerned.

Ever since man commenced to grow food-crops it has been recognized that no inconsiderable portion of the crops, which he grows for his own use, is devoted to the upkeep of the Insect World, to which tribute is paid both before and after harvest. The discovery of the rôle of Insects as disease-carriers naturally created more alarm, from the realization of the fact that insects were an actual danger as constituting a direct attack on man's person, than they had caused as a threat to his food-supply. Hence to a large degree the rather late and sudden realization of the importance of Applied Entomology and its rapid growth during the present century, and at the present time the general public is probably more interested in disease-carrying insects than in insect pests of crops. But in the future, as the human race increases in numbers and its food-supply becomes a more pressing problem, the proportion of crops which can be yielded to insects must become less, until control of the crop-pests will have become also a question of preservation of the human race.

The horizon of the ordinary Government official is usually limited to his own country or district, but insects have no respect for political boundaries. Many of the worst pests, indeed, are practically world-wide

in their range, having been carried by modern transport to new countries, where they have wrought even more damage than in their original homes, and this modern danger, linked with the control of plant imports, has also had a large share in the recognition of the importance of Applied Entomology, and the Economic Entomologist nowadays has not only to deal with the pests of his own country but has to endeavour to exclude foreign insects, which may become pests if imported. If his information is to be adequately complete, therefore, he must study the habits and control of insects, which are known or are likely to be pests, practically throughout the world, and must also know something of insects which may be employed to check weeds, and so on.

The methods of control of insects have also changed greatly during the last half-century. Fifty years ago, the stock-in-trade of the economic entomologist consisted largely of arsenicals and kerosine-emulsion, with a little pyrethrum for household insects, and little practical use was made of natural control by parasites, predators or diseases. Nowadays, methods of biological, chemical, mechanical and legislative control produce an ever-increasing volume of information to be assimilated and practised by the economic worker, and it is impossible to refer even briefly to all such methods in a short *résumé*. In the United States alone, for example, the U.S. Patents relating to Pest Control provide material for a monthly Review on this one subject. The technique of the introduction and breeding of parasites is large and complex and the necessity for the study of recently-introduced pests in their original homes is also a development of recent years.

Special training of Economic Entomologists is also a development within the last three decades. Previously, work in Applied Entomology was usually carried out by entomologists—often at first appointed in an honorary capacity, of which one effect was to retard progress, as Governments are apt to regard as of little importance scientific work which is done for them free of charge and usually without thanks—who had an innate keenness for the study of insects. Nowadays, recruitment to such posts is usually made from students trained *ad hoc*. With a few exceptions to prove the rule, however, it seems doubtful whether the modern method produces very satisfactory results—and I have heard the same criticism in other branches of biological work, in which the innate keenness of the man concerned seems to be the most important item in his equipment.

And the future? Here we may perhaps quote the words of Dr L. O. Howard, who has played such a great part in the development of Economic Entomology:—"The intelligence of the human race, *if brought to bear*, will conquer the insect menace."

THE DERMAPTERA: HISTORICAL NOTES.

By W. D. HINCKS, F.R.E.S.

The study of the Dermaptera or Earwigs in its early stages was bound up with the Orthoptera of which Order they were long regarded as a family, the *Forficulidae*. Even now many naturalists find it difficult to dissociate the two Orders in their minds, although it is probable that they are really not closely related. It is true that the very limited